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Füllemann et al.

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[54] **FEEDING DEVICE FOR FEEDING PULVEROUS OR GRANULAR MATERIAL FROM A CONTAINER TO A MATERIAL CONSUMING APPARATUS**

[75] Inventors: **Jörg Füllemann,** Mastrils; **Heinrich Boner,** Malans; **Erik Granwehr,** Mastrils, all of Switzerland

[73] Assignee: **VTH AG,** Vaduz, Liechtenstein

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[4] **B65G 65/00**

[52] **U.S. Cl.** **414/326;** 222/242; 198/533; 198/550.1

[58] **Field of Search** ..... 414/310, 319, 320, 321, 414/326; 198/533, 550.1; 222/239, 242 X, 249

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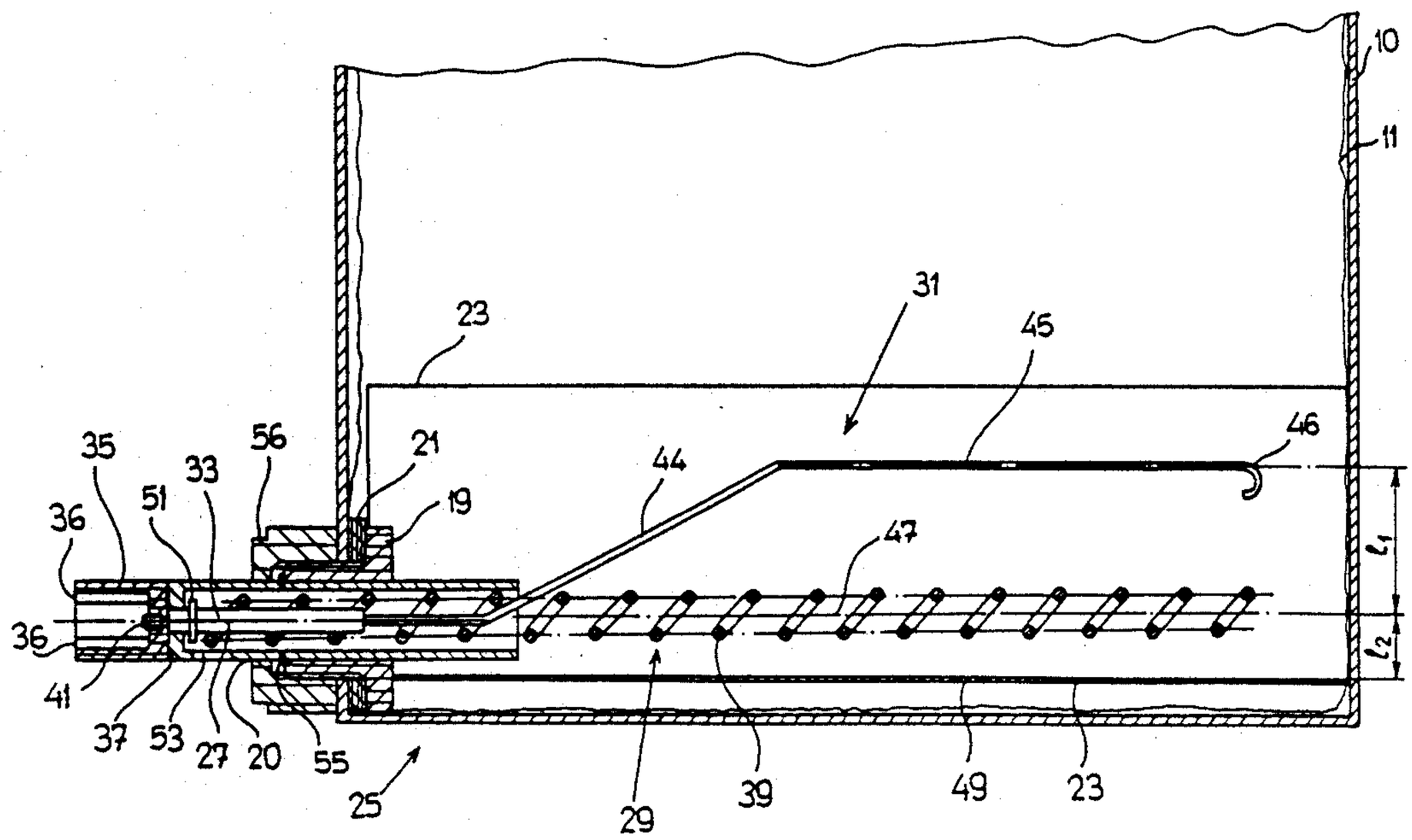
Primary Examiner—Robert J. Spar
Assistant Examiner—James R. Bidwell

[57] **ABSTRACT**

A container (**10**) comprising a trough (**23**) is filled with pulverous or granular material, for example a neutralizing agent for sulphuric acid. At the place where the container (**10**) is used, for example on a waste gas cleaning apparatus, a subassembly (**27'**) is pushed through an opening (**20**). The subassembly (**27'**) comprises substantially an axial feed member (**29**) having the form of a helical spring, a loosening member (**31**), a rotatable shaft (**33**), and a coupling member (**35**). When rotational motion is transmitted from a drive to the coupling member (**35**) the screw (**39**) is rotated and the loosening member (**31**) which is periodically pressed by the trough (**23**) against the screw (**39**) loosens the granular or pulverous material, so that it glides towards the axial feed member (**29**). The axial feed member (**29**) transports the material from the interior of the container (**10**) to the outlet (**53**). When the container (**10**) is empty, the subassembly (**27'**) is removed and inserted into a new container (**10**). The old container may then be discarded.

22 Claims, 4 Drawing Sheets



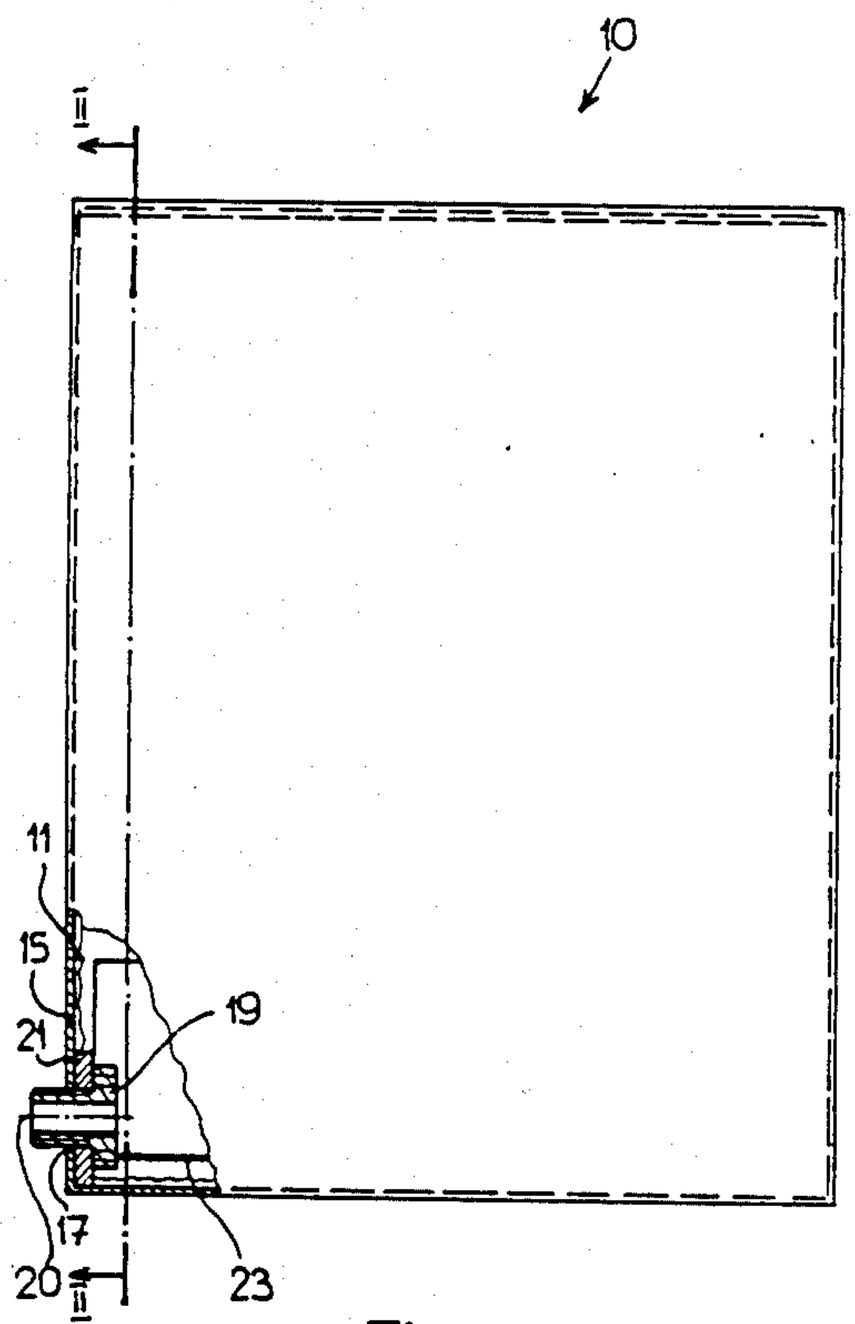


Fig. 1

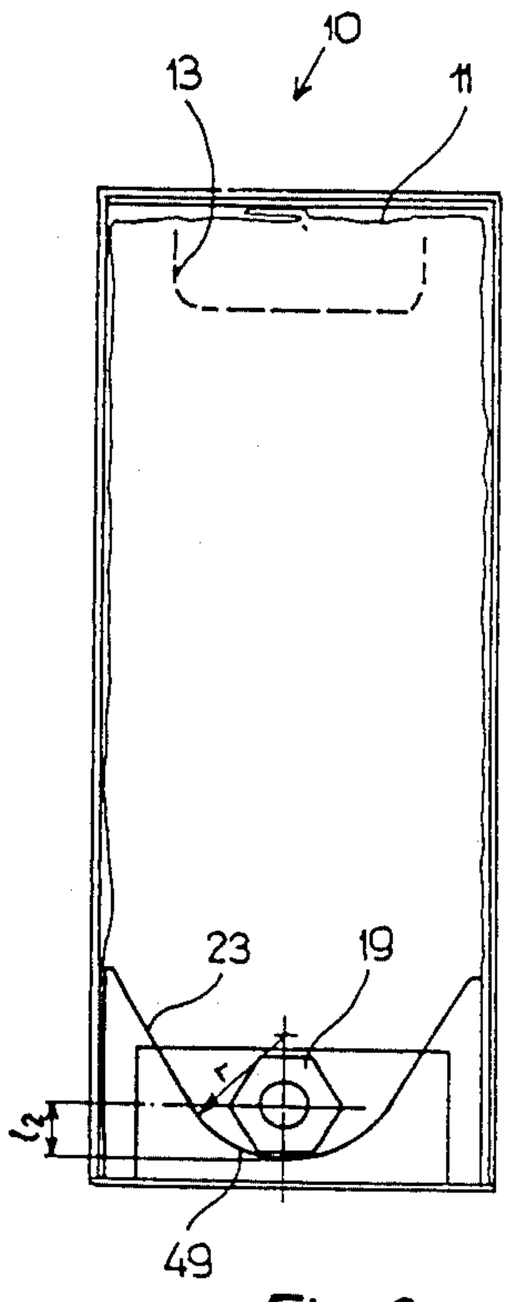
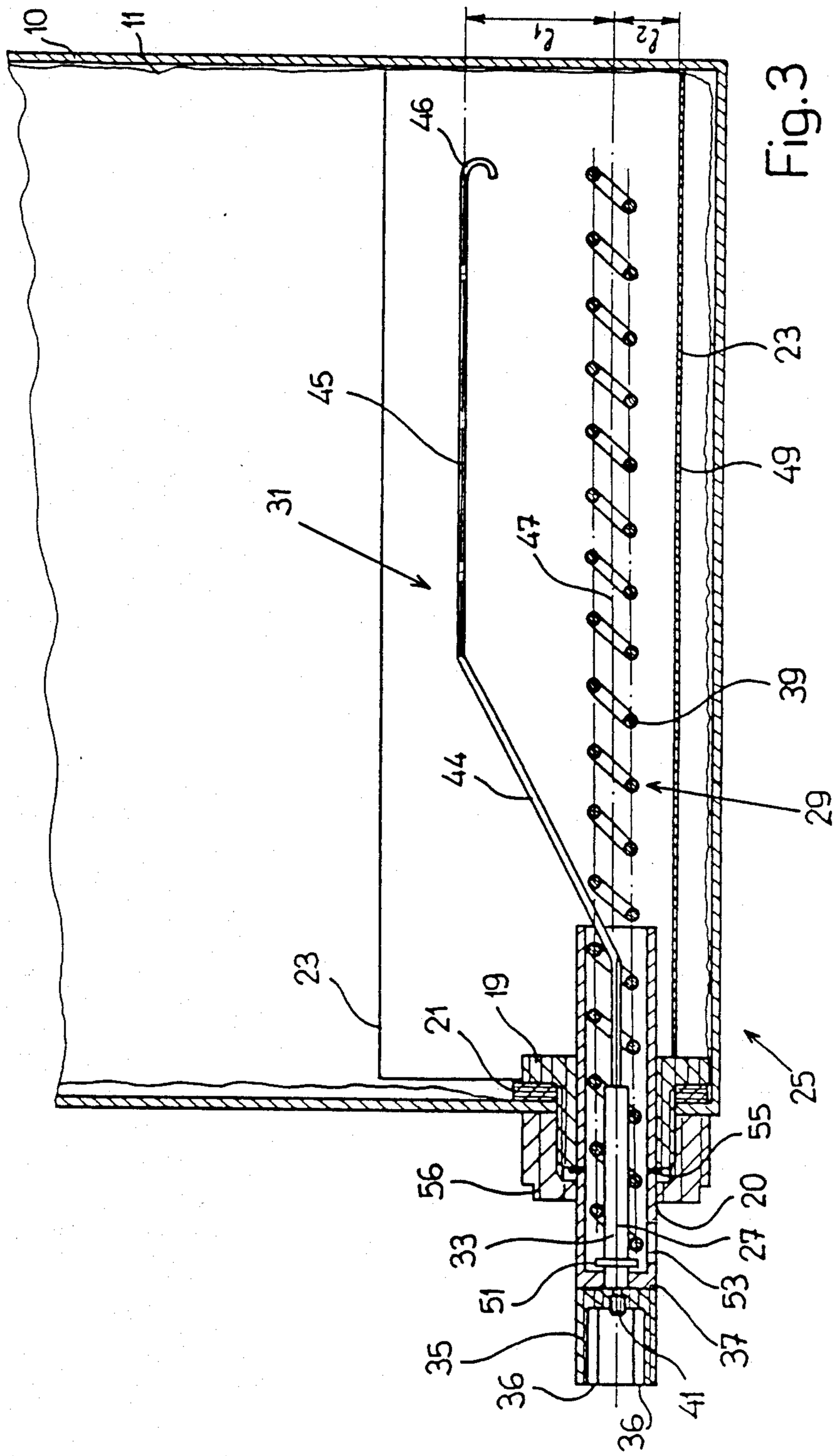


Fig. 2


10
11
ℓ_1
ℓ_2
46
45
31
47
44
23
49
39
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41
37

Fig.3

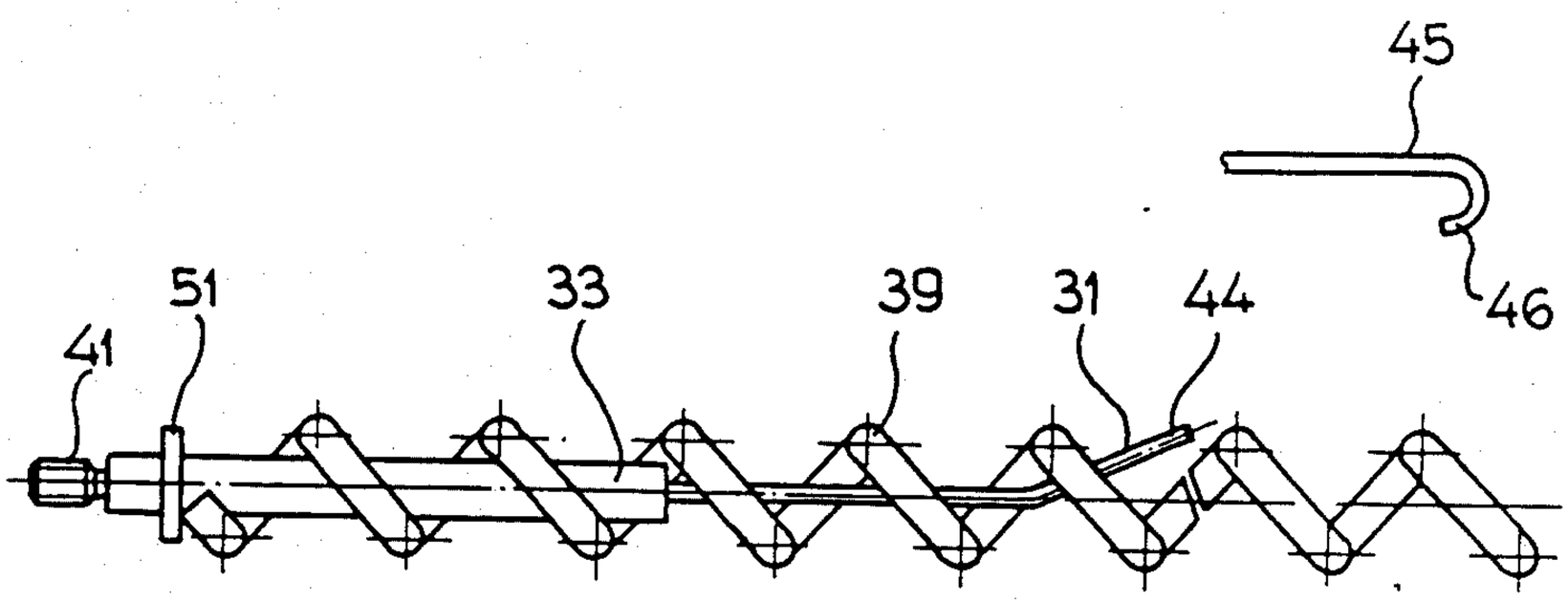

Fig.4

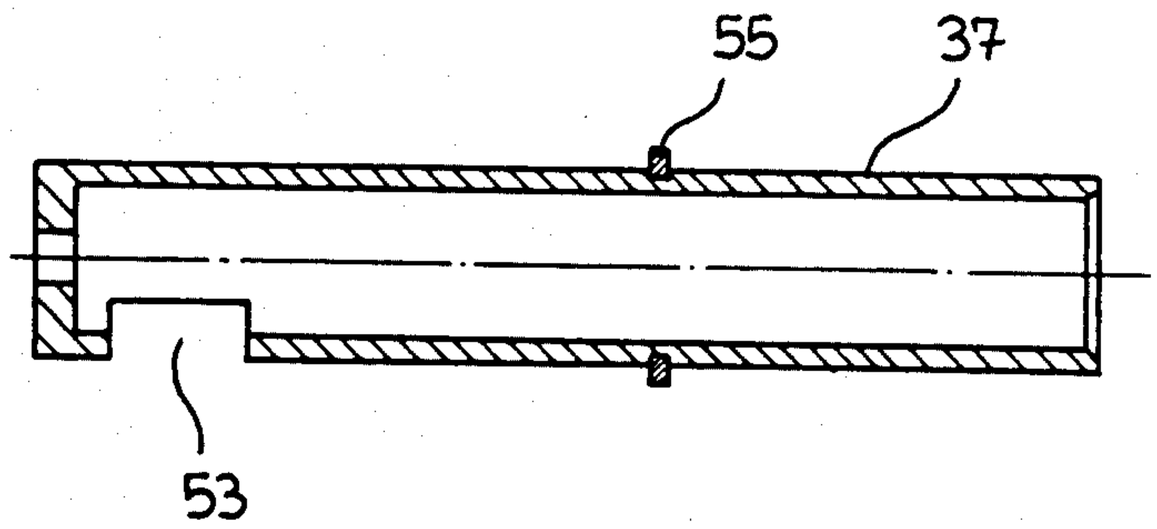

Fig.5

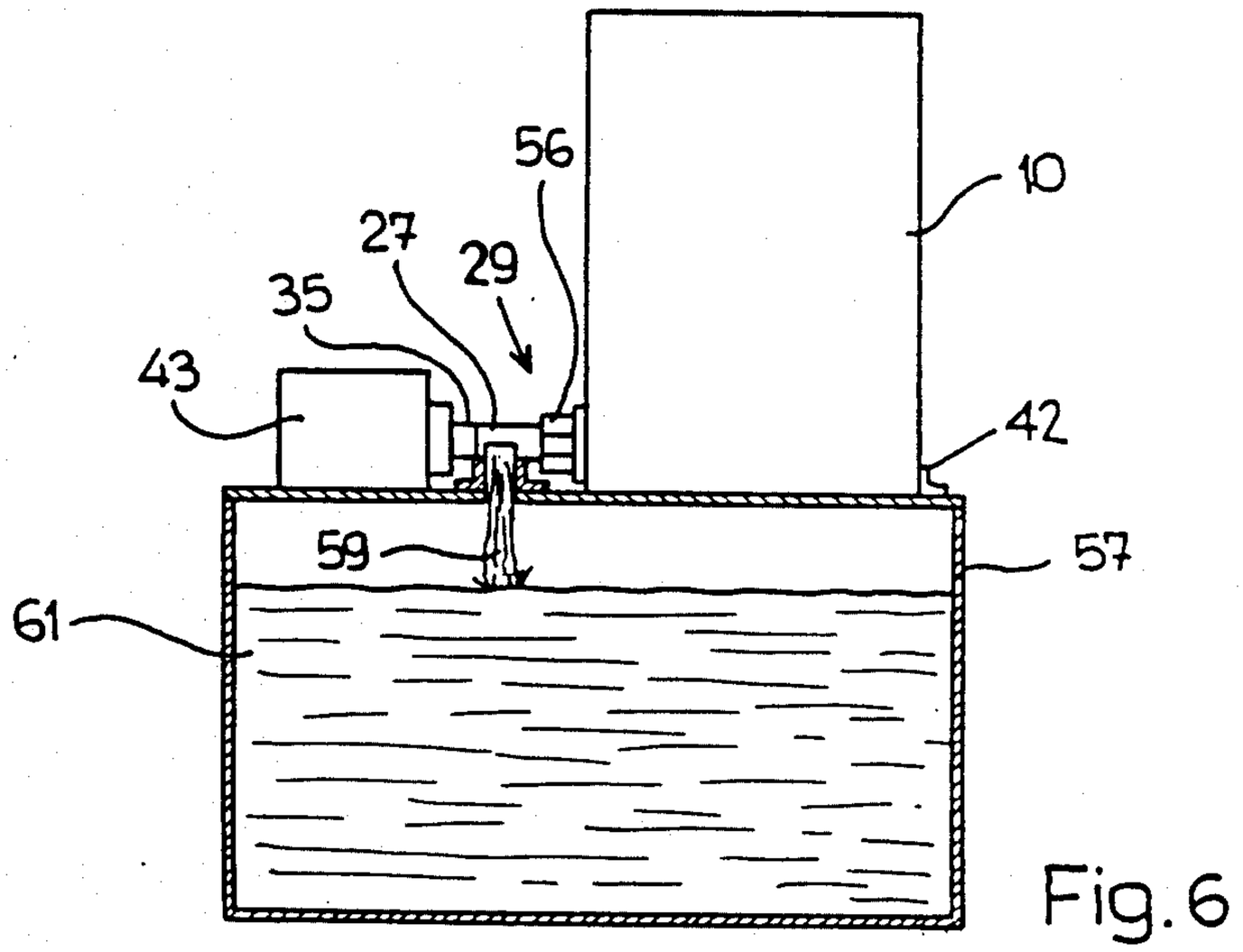

Fig.6

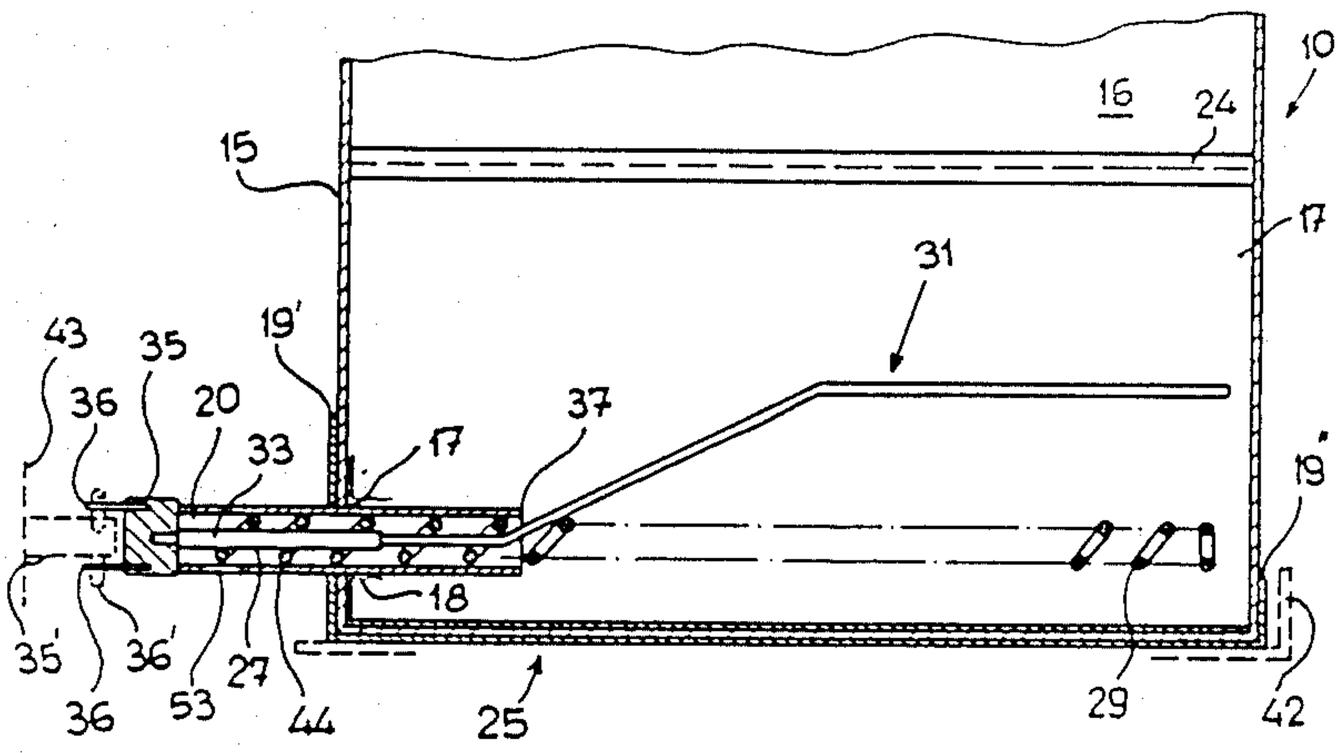
10
16
24
15
17
31
19'
43
35
36
20
33
37
17
19
18
35'
36'
36
53
27
44
25
29
42

Fig. 7

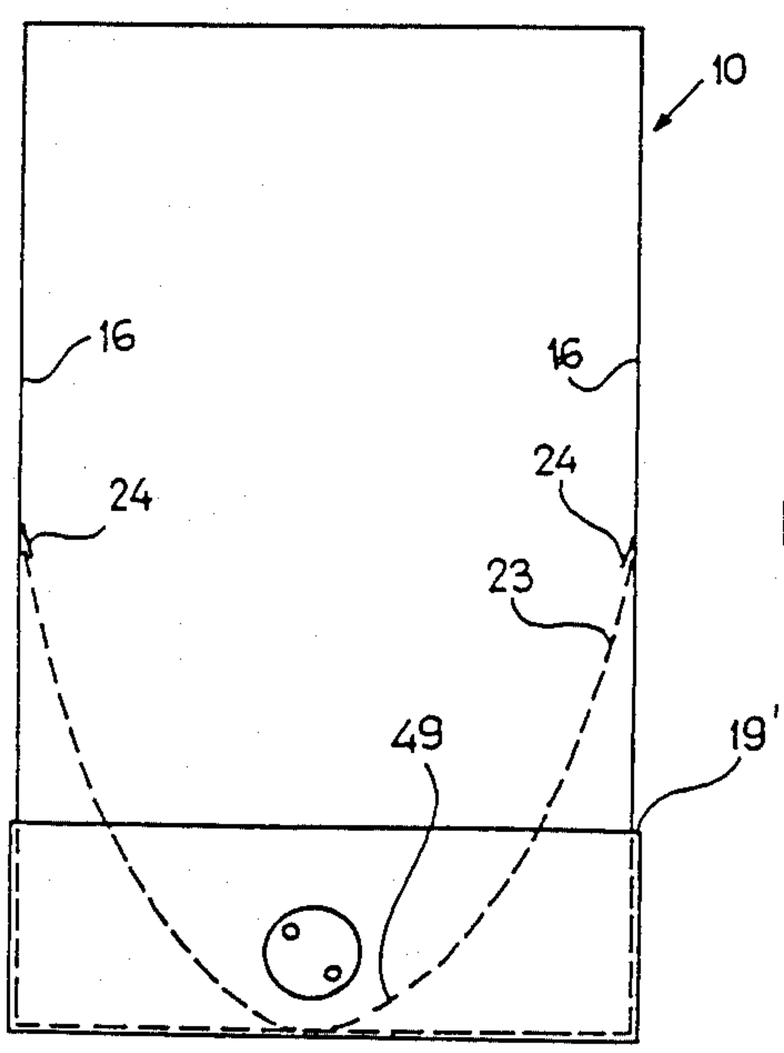
10
16
16
24
24
23
49
19'

Fig. 8

FEEDING DEVICE FOR FEEDING PULVEROUS OR GRANULAR MATERIAL FROM A CONTAINER TO A MATERIAL CONSUMING APPARATUS

The present invention relates to a feeding device for feeding pulverous or granular material from a container to a material consuming apparatus and more particularly to a feeding device for a feeding a pulverous or granular neutralizing agent to an apparatus for cleaning waste gases from heating systems.

BACKGROUND

U.S. Pat. No. 4,686,940 describes a device for cleaning waste gases from heating systems, in particular heating systems for single or multiple family houses. On this cleaning device the waste gas from the boiler is fed through a chamber in which a mist or rain of a liquid is generated. Periodically, controlled by a control device, milk of lime is added as neutralizing agent to the water in the container. The feeding of neutralizing agent occurs by hydraulic pressure. This is controlled by a magnet valve. This causes water to flow into the neutralizing agent storage means so that neutralizing agent is fed over a pipe into the container in which the cleaning of the waste gas takes place. Because the suspension of lime in water has the tendency to solidify in time, clogging may occur so that no neutralizing agent is anymore transported. If the acid condensates are not anymore neutralized they can cause corrosion and thus destruction of the waste gas cleaning device.

It would seem advisable to use pulverous or granular neutralizing agents instead of liquid neutralizing agents or suspensions of solid neutralizing agents in water. For example, caustic lime could be used as neutralizing agent. However, caustic lime and also some other pulverized and granular neutralizing agents are relatively dangerous substances which can cause cauterization or burns. A special danger occurs when such substances enter the eyes. In addition, the feeding of pulverized substances is considerably more difficult than feeding of fluid substances. Fluid substances can be easily fed by means of valves or pumps. This may be the reason why up to the present time pulverous or granular neutralizing agents have not found application in waste gas cleaning apparatus of small or medium size.

There exist feeding devices for feeding pulverous or granular material from a container to a consuming device by means of an axial feeding member, for example a screw. However, pulverous material has a tendency to stick or clump together. Accordingly, screw feeding devices may turn empty, that is may not feed material, if not additionally vibrators are provided to cause a steady gliding down of material towards the feed screw. But sometime vibrators do not have the desired effect. They also generate undesirable noise.

THE INVENTION

It is an object of the present invention to provide a feeding device for feeding pulverous or granular material from a container to an apparatus consuming such material, and more particularly for use in exchangeable containers, which permits the transport of pulverous or granular material without danger. The feeding device should be easy to insert into the container, and the container should be easy to position on the apparatus using the pulverous or granular material. It is further an object of the present invention to provide a feeding device not requiring vibrators but nevertheless providing a secure gliding down of the pulverous or granular material in the container to the axial feeding device for further transportation by said axial feeding device.

Briefly, a movable loosening member is located at a distance from the axial feed member. In accordance with the present invention, thus, in operation of the feeding device, the loosening member loosens the material in the neighbourhood of the axial feed member so that it always engages and transports material when the material consuming apparatus requires such material.

The axial feed member and the loosening member are preferably driven by a common drive means. This has the advantage that a single drive means is sufficient to carry out the feeding and loosening operations.

It is of advantage to use a screw as axial feed member. Accordingly, a rotary motion is sufficient to provide a feeding action in axial direction. It is of particular advantage if the screw has the form of a helical spring with spaced windings. This is not only an inexpensive design but has the additional advantage that the helical winding can easily be introduced into an opening of a container filled with the pulverous or granular material. The helical spring can be screwed without much effort into the pulverous or granular material. Preferably, the helical spring is connected to a shaft capable of being driven by the drive means. On the shaft a coupling member may be provided to couple the axial feed member and the loosening member to the drive means. This permits the location of the container with the feeding device on an apparatus requiring the material in the container and having drive means to operate the feeding device.

The loosening member is preferably flexible, for example a flexible wire. This permits the loosening member to scan a relatively large region and to loosen within its reach the pulverous or granular material. The loosening member may comprise an exterior section which, in unloaded condition of the loosening member, extends at a distance from the axial feeding member and practically parallel thereto. Further, it is preferred that the part of the loosening member which extends from the shaft to the exterior part is located at an acute angle to the axis of the axial feeding member. This permits, on insertion of the axial feed member into the container, to press the loosening member with the fingers of the hand towards the axial feed member and then to push them together through the opening of the container. This causes the loosening member to be further pressed against the axial feeding member, but after complete introduction into the container the loosening member can relax, because it is flexible. Preferably, the free end of the exterior part of the loosening member is bent to form a hook pointing in direction of rotation of the screw. When the screw rotates this hook digs into the material and loosens it, so that it is moved towards the screw. A trough may be provided underneath of the axial feed member. This trough cooperates with the axial feed member. The cross-section of the bottom of the trough has preferably a radius. The distance of the axial feed member from the bottom of the trough is preferably smaller, for instance two to three times smaller, than the radius of the bottom of the trough. This has the effect that, on rotation, the loosening member touches with its exterior part the sidewalls and the bottom of the trough. This causes sticking material to become loose, and the loose material is then engaged by

the axial feed member and transported by it. It has been found to be of advantage if said distance of the axial feed member from the bottom of the trough is for example two to three times shorter than the radius of the bottom of the trough. The trough preferably .has slightly movable and/or flexible walls. Accordingly, when the loosening device contacts the trough the trough is somewhat moved and/or deformed on each revolution. The movement of the trough walls with respect to the container walls causes the pulverous material to glide downward from the upper regions into the region where the axial feed member is located and where it will be transported by it.

Advantageously, one end of the axial feed member is rotatably supported in a tubular bushing, said bushing being provided with a peripheral opening providing an outlet for the material being fed. The axial feed member, the loosening member, the shaft and the coupling member may form a subassembly. Such a subassembly can then be pushed through the opening of a container until it is stopped by an abutment.

DRAWINGS

FIG. **1** is a schematic view, partly in section, of an exchangeable container according to a first embodiment;

FIG. **2** is a section along the line II—II of FIG. **1**;

FIG. **3** is a longitudinal section through the container of FIG. **1** and ,the feeding device;

FIG. **4** is a view of the axial feeding member together with the loosening, member;

FIG. **5** is a section through the bushing in which the axial feeding/;member is rotatably supported at one end;

FIG. **6** is a schematic view of an exchangeable container on a flue gas cleaning installation, said container containing neutralizing agent;

FIG. **7** is a longitudinal section through a container with feeding device, according to a second and preferred embodiment of the invention; and

FIG. **8** is a side view of the container with feeding device according to FIG. **7**.

DETAILED DESCRIPTION

The exchangeable container according to FIGS. **1** to **3** is preferably a moisture-proof cardboard box. If the cardboard box is not moisture-proof the pulverous or granular material should be in a bag, preferably a plastic bag which in FIGS. **2** and **3** is indicated by the reference numeral **11**. Instead of a cardboard container also a container of plastic material or metal could be used. However, cardboard boxes are very inexpensive and disposable without ecological problems. On a cardboard container handles may be provided by cuts **13**.

For clarity of representation the container **10** is shown in FIGS. **1** to **3** in empty condition. In the lower part of a side wall **15** the container **10** has an opening **17** in which a hollow screw **19** of plastic material is located. The hollow screw **19** is connected to a plate **21** of plastic material. This plate **21** prevents rotation of the screw.

The feeding device **25** which is shown in details in FIGS. **3** to **5** comprises substantially a subassembly **27** and a trough **23**. The trough **23** may be of plastic material and is located at the bottom of the container **10**. The subassembly **27** can be inserted into the container **10** through an opening **20**. If it is acceptable that the feeding device **25** does not practically completely empty the container **10** the trough **23** could be omitted.

On this embodiment the subassembly **27** comprises an axial feeding member **29**, an loosening member **31**, a shaft **33**, a coupling; and member **35** and a bushing **37**.

The axial feeding member **29** is a kind of feed screw which is formed by a helical spring **39** having spaced windings. The helical spring **39** consists of relatively thick wire, e.g. of the stainless steel, and therefore is relatively stiff. Accordingly, in this description the expression helical spring is mainly used to designate the form. On the side of the drive means the helical spring **39** is mounted on the shaft **33**, e.g. by brazing. The shaft **33** has a threaded portion **41** on which the coupling member **35** is threaded. This coupling member **35** has claws **36** engaging a coupling member (not shown) of the drive means **43** (FIG. **6**).

One end of the loosening member **31** which may be made of stainless spring steel is connected to the shaft **33**. Accordingly, in operation, the loosening member **31** is rotated together with the helical spring **39**. On the embodiment shown the loosening member **31** comprises a flexible piece of wire. The interior part **44** of this piece extends at an acute angle to the axis **47**. In unloaded condition the exterior part **45** is located practically parallel to the axis **47** and comprises at its end a hook **46** extending approximately in direction of rotation of the axial feed member **29**. The distance 1_1 between the exterior part **45** and the axis **47** is about three times larger than the distance 1_2 of the axis **47** from the bottom **49** of the trough **23**. The distance 1_2 is approximately two to three times smaller than the radius r (FIG. **2**) of the bottom **49** of the trough. Accordingly, when rotated, the exterior part **45** of the loosening member **31** wipes the bottom **49** of the trough **23**. One end of the axial feed member **29**, that is the part **44** of the helical spring **39** which is connected with a shaft **33**, is located in the tubular bushing **37**. An axial movement is prevented on one hand by a flange **51** and on the other hand by the coupling member **35**. At the end of the bushing **37** located outside of the container **10** is a peripheral opening **53** serving as outlet for the transported material. On the bushing **37** is a snap ring **55** preventing an axial movement of the bushing when a cap screw **56** is screwed on the hollow screw **19**.

As FIG. **6** schematically shows, the container **10** can be employed on a consuming device, e.g. a waste gas cleaning apparatus **57**. When the container **10** is placed on the consuming device the feeding device **25** is engaged with the drive means **43**. As drive means **43** an electric motor may be used which is set in operation on demand. When the feeding device **25** is rotated neutralizing agent **59** is added to the water **61** of the waste gas cleaning apparatus **57**.

An exchange of an empty container **10** by a full container takes place as follows: The empty container **10** is taken from the consuming device **57**. The cap screw **56** is removed, and the subassembly **27** is pulled out from the container **10**. Because a new container **10** is closed by a screw cap (not shown) threaded on the thread of the hollow screw **19**, this screw cap is first removed and then the subassembly **27** is pushed through the opening **20** into the container **10**. Then the subassembly **27** is fixed with the screw **56** in the axial position shown in FIG. **3**. Now the container **10** can be put on the consuming device **57**.

The preferred embodiment according to FIGS. **7** and **8** comprises a particular simple and safely operating

feeding device which is similar to that of FIGS. **1** to **5**. Accordingly, the same reference numerals designate parts having the same functions. For details reference may be made to the previous description.

The container **10** is preferably a cardboard container of the kind generally used for washing powder. Such containers are moisture-proof, so that no additional plastic bag is required to provide protection from moisture.

In the lower part of the sidewall **15** an opening **17** is provided. In contrast to the first embodiment no hollow screw with a screw cap is required. Accordingly, such disposable parts of plastic material are avoided, which is advantageous for ecological reasons. The opening **17** is closed with a closure foil, for example an adhesive tape **18** or the like. On insertion of the bushing **37** this closure foil is pierced.

Located in the container **10** is a trough **23** which may consist of a thin plate of plastic material having its lateral walls connected with adhesive tape **24** on the inner walls **16** of the container.

The bushing **37** is connected on a receptacle **19'**. To place the container **10** into the receptacle **19'** it is put with the opening **17** directed towards the bushing **37** on the receptacle **19'** and then pushed against the bushing **37**. After the bushing **37** has pierced the closure foil **18** and has further entered into the container **10**, the container **10** comes to a rest in the position shown in FIG. **6**. In this position a rim **19''** encloses the container **10** and prevents it from sliding off therefrom.

As on the first embodiment described previously, the feeding device **25** of the second embodiment comprises substantially a subassembly **27'** and a trough **23**. The subassembly **27'** can be inserted through the opening **20'** of the bushing **37**.

On this preferred embodiment the subassembly **27'** comprises an axial feed member **29**, a loosening member **31**, a rotatable shaft **33** and a coupling member **35**. In contrast to the first embodiment, the bushing **37** does not belong to the subassembly **27**, but is connected to the receptacle **19'** The container **10** can be inserted together with the receptacle **19'** on a consuming device, for instance a waste gas cleaning apparatus **57**, as shown in FIGS. **6** and **7**. Claws **36** (FIG. 7) engage claws **36'** so that the shaft **33** is coupled to the drive means **43**. The abutment **42** on the apparatus **57** fixes the container **10** in its position thereon.

Replacement of an empty container **10** by a full container takes place as follows:

The empty container **10** is taken together with the receptacle **19'** from the consuming device **57**. Then the subassembly **27'** is pulled out of the container **10**, and then the empty container **10** is taken off from the receptacle **19'**.

The new container is pushed into the receptacle **19'**, thus causing the bushing **37** to pierce the foil **18**. Then, the subassembly **27'** is pushed through the bushing **37** into the container **10**.

OPERATION

In operation the feeding device operates as follows: If pulverous or granular material must be fed from the container **10** to the consuming device **57** the motor **43** is operated. By the coupling member **35** rotation is transmitted to the subassembly **27** (**27'**). Accordingly, the axial feed member **29** is also rotated so that by the windings **39** the powdery or granular material **59** is fed through the bushing **37** to the opening **53** and therefore into the consuming device **57**. The loosening member **31** is rotated in the pulverous material so that this material is moved into the region of the windings **39** and transported by these windings. On its rotation the exterior part **45** contacts the trough **23**, and, in the region of the bottom **49** of the trough **23** is pressed in close proximity of the axial feed member **29**. During the further rotation the exterior part **45** flexes back approximately into the position shown in FIG. **3**. By this operation the pulverous or granular material is loosened and gets, as already mentioned, into the region of the axial feed member **29**. The loosening of material is further facilitated by the slight deformation and motion of the walls of the trough **23** caused by contacts of the loosening member **31** on each of its revolutions.

While the invention has been particularly shown and described with reference to embodiments thereof, it will be understood by those skilled in the art that various alterations in form and detail may be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which exclusive property or privilege is claimed are defined as follows:

We claim;

1. A feeding device for feeding pulverous or granular material from a container to an apparatus for receiving said material, said container having sides and a substantially horizontal bottom thereof, said feeding device comprising:

axial feed means having its axis located substantially parallel to and at a predetermined distance 1_2 from the bottom of said container;

movable, flexible loosening means and means for rotating said loosening means about said axis for loosening said material in said container, said loosening means having at least an exterior section thereof being located, when furthest from said bottom, at a distance 1_1 from said axis,

said distance 1_1 of said loosening means from said axis of said feed means being larger than said predetermined distance 1_2 so that scraping of said bottom by said exterior section of said loosening means occurs during each revolution of said loosening means about said axis.

2. The feeding device of claim **1** wherein said axial feed means comprises a feed screw.

3. The feeding device of claim **1** wherein said axial feed means comprises a helical spring having spaced windings.

4. The feeding device of claim **1** wherein said loosening means is connected with one end to the axial feed means.

5. The feeding device of claim **1** wherein said loosening means comprises said exterior section and an interior section, said interior section extending away from said drive shaft at an acute angle towards said exterior section.

6. The feeding device of claim **1**, including a common drive means for driving said axial feed means and said means for rotating said loosening means.

7. The feeding device of claims **1** wherein said exterior section terminates in a hook.

8. The feeding device of claim **1** including a drive shaft and a coupling means for coupling said axial feed means and said loosening means to said drive shaft; and,

wherein said axial feed means, said loosening means, said drive shaft, and said coupling means form a subassembly.

9. The feeding device of claim 1 wherein said axial feed means is operative for feeding said material out of said container and wherein said axial feed means comprises;

a common drive means;

a helical spring having spaced windings;

a drive shaft for rotating said helical spring;

bearing means for rotatably supporting said drive shaft; and,

coupling means for coupling said axial feed means and said loosening means to said common drive means.

10. The feeding device of claim 1 including a trough having a round cross-section located at the bottom of said container for facilitating feeding of said material, said trough being located in said container underneath said axial feed means.

11. The feeding device of claim 10 wherein said axial feed means comprises a feed screw.

12. The feeding device of claim 10 wherein said axial feed means comprises a helical spring having spaced windings.

13. The feeding device of claim 10 wherein said loosening means is connected with one end to the axial feed means.

14. The feeding device of claim 10 wherein the distance of said axial feed means from said bottom is about 2–3 times shorter than the radius of said round cross-section of said bottom.

15. The feeding device of claim 10 wherein said trough has flexible walls.

16. The feeding device of claim 15 wherein said trough is comprised of a thin plate fastened at its edges to two opposing inner walls of said container.

17. The feeding device of claim 1 including a receptacle for receiving said container.

18. The feeding device of claim 1 including a receptacle for receiving said container and wherein a bearing means is mounted on said receptacle.

19. The feeding device of claim 1 wherein the distance of said loosening means from the axis of said axial feed means is about 2–3 times larger than the distance of said axis from said bottom.

20. The feeding device of claim 18 wherein said trough has flexible walls.

21. The feeding device of claim 19 wherein said trough is comprised of a thin plate fastened at its edges to two opposing inner walls of said container.

22. A feeding device for feeding pulverous or granular material from a container to an apparatus for receiving said material, said container having sides and a substantially horizontal bottom thereof, said feeding device comprising:

axial feed means having its axis located substantially parallel to and at a predetermined distance 1_2 from the bottom of said container;

movable, flexible loosening means and means for rotating said loosening means about said axis for loosening said material in said container, said loosening means having at least an exterior section thereof being located, when furthest from said bottom, at a distance 1_1 from said axis;

said distance 11 of said loosening means from said axis of said feed means being larger than said predetermined distance 1_2 so that scraping of said bottom by said exterior section of said loosening means occurs during each revolution of said loosening means about said axis; and,

wherein said axial feed means comprises:

a common drive means;

a helical spring having spaced windings;

a drive shaft to which said helical spring is connected;

bearing means for rotatably supporting said drive shaft;

coupling means for coupling said axial feed means and said loosening means to said common drive means;

a trough having a bottom of round cross-section for facilitating feeding of said material, said trough being located in said container underneath said axial feed means; and,

wherein said bearing means comprises a tubular bushing, said bushing being provided with a peripheral opening to provide an outlet for the material being fed.

* * * * *